(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
3 November 2005 (03.11.2005)

PCT

(10) International Publication Number
WO 2005/102883 A1

(51) International Patent Classification[7]: B65G 53/28

(21) International Application Number:
PCT/GB2005/001606

(22) International Filing Date: 27 April 2005 (27.04.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0409318.3 27 April 2004 (27.04.2004) GB

(71) Applicant *(for all designated States except US)*: **HALLIBURTON ENERGY SERVICES, INC.** [US/US]; PO Box 1431, 2600 2nd St, Duncan, OK 73536-0440 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **MORRIS, Ronald, George** [GB/GB]; Cedarwood, 5 Graham Street, Montrose, Angus DD10 8SR (GB).

(74) Agent: **MURGITROYD & COMPANY**; Scotland House, 165-169 Scotland Street, Glasgow G5 8PL (GB).

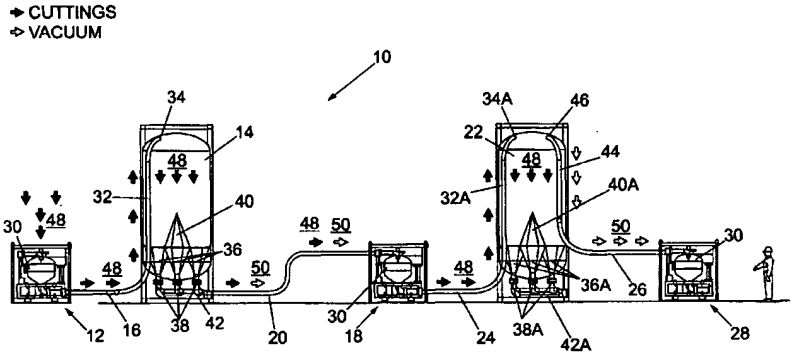
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A METHOD AND AN APPARATUS FOR CONVEYING PARTICULATE MATERIAL



(57) Abstract: A method of, and apparatus for, transferring material, which may be hydrocarbon exploration and production industry by-products in the form of drill cuttings (48), from a first location to a second location is described. A first container (14) is provided containing fluid and the material is transferred from a first location outside of the container (14) to a second location inside the container (14). Fluid, which is typically air, is at least partially evacuating from within the container (14) in order to facilitate progression of the material into the container (14).

WO 2005/102883 A1

A METHOD AND AN APPARATUS FOR CONVEYING PARTICULATE MATERIAL

The present invention relates to apparatus and a method for transporting material, and particularly but not exclusively relates to apparatus and a method for transporting non free flowing or relatively sticky paste-like materials such as those produced by hydrocarbon exploration and production operations.

In the hydrocarbon exploration and production industry it is often necessary to transfer large quantities of material from, for example, a drill rig to a transport vessel in order that the material can then be transported to an on-shore location for further processing/disposal. The materials used in/created by drilling operations such as drill cuttings, pastes or sludge are often highly viscous substances which are therefore difficult to transport due to their cohesive properties. One way of transporting such materials is to empty them into a container or skip and then transport the container

or skip onto a vessel; however manoeuvring the container or skip around the rig, as required in such a method, presents a number of dangers to personnel operating on the rig.

In order to transfer drill cuttings from the rig to the vessel more safely it is known to transfer the drill cuttings firstly to a number of large holding tanks. When the holding tanks are full, they are connected via tubing to transport tanks on board a transport vessel and transferred thereto using compressed air or a similar propellant in order to assist progression of the material along the tubing; however such systems can become blocked due to the difficulty in obtaining a large enough pressure differential along the long distance of tubing between the rig and the vessel. The tendency for highly viscous materials to stick together rather than to flow, combined with the fact that the long tubing has a tendency to sag thereby creating certain areas along the pipe where the flow of the highly viscous materials must act against gravity, makes blockages along the pipe more likely.

According to the present invention there is provided a method of transferring material from a first location to a second location comprising the steps of:-

providing a container containing fluid;

transferring material from a first location outside of the container to a second location inside the container; and

at least partially evacuating fluid from within the container in order to facilitate progression of the material into the container.

Preferably, the transfer of material from the first location to the second location and evacuating the fluid from the container are performed substantially simultaneously.

Preferably, the method further comprises the step of transferring the material along a first conduit under application of pressure upstream of the material, in order to progress the material from a first location outside of the container to a second location inside the container.

Preferably, the method further comprises the step of at least partially evacuating the fluid, which is preferably gaseous and is more preferably air, from the container along a second conduit in order to substantially create a vacuum within the container.

Preferably, the fluid is at least partially evacuated from the container whilst substantially avoiding removal of the material from the container.

Preferably, the method further comprises the step of providing a second container, which is typically upstream of the first container, where the second upstream container typically provides a temporary storage facility for material to be transported.

Typically, the method further comprises the step of providing a first pumping means for pumping material which may be from a source of material into the second container under pressure such that the material may be deposited in the second container prior to being transferred to the first container. More preferably, pressure is applied to the second container and the material therein when the second container contains a desired level of material. More preferably, the second container is then emptied by evacuating at least a portion of the material within the second container, typically along a discharge conduit, which action is preferably assisted by the pressure applied to the second container.

Preferably, the discharge conduit is in fluid communication with the first conduit via an intermediate or transfer pumping and/or vacuum generation means in order to allow the material from the second container to be conveyed to the first container.

Typically, the first container is located on a transportation means such as a sea going vessel and the second container is located proximal to the first pumping means and also is preferably located proximal to a supply of the material such as a primary drill cuttings source such as on a drilling rig. Preferably, the intermediate or transfer pumping and/or vacuum generation means is located proximal to and downstream of the second container.

Typically, a transfer conduit connects the intermediate or transfer pumping and/or vacuum generation means to the first container.

Preferably, the material comprises drill cuttings.

According to the present invention there is provided material transfer apparatus comprising:-

a container containing fluid;

material transfer means adapted to transfer material from a first location outside the container to a second location inside the container; and

material urging means adapted to facilitate transfer of the material from the first location to the second location by at least partially evacuating fluid from within the container.

Preferably, the material transfer means comprises a first tubular conduit which passes through an inlet portion of the container and more preferably further comprises an intermediate or transfer pumping and/or vacuum generation means connected thereto.

Preferably, the intermediate or transfer pumping and/or vacuum generation means comprises a pump and a vacuum device and is adapted to be selectively switched between the pumping and vacuum producing modes as desired.

Preferably, the intermediate or transfer pumping and/or vacuum generation means also comprises an

intermediate storage tank and is typically located upstream of the container.

Preferably, the material urging means comprises a second tubular conduit which passes through an outlet portion of the container and more preferably further comprises vacuum generation means connected thereto.

Preferably, the inlet and outlet portions are spaced apart across a diameter of the first container in order to prevent material exiting the inlet portion from entering the outlet portion. Optionally, a filter may also be provided on the outlet portion to further prevent the material from entering the outlet portion and hence the vacuum generation means. Typically, the inlet and outlet portions are located toward the upper end of the first container.

Typically, the fluid is gaseous and preferably is air.

Typically, the material is a highly viscous material which is typically drill cuttings or similar hydrocarbon exploration and production industry by-products.

Embodiments of the invention have the advantage that they allow material to be pumped by the intermediate or transfer pumping and/or vacuum generation means along the first conduit until it is expelled into the container from the inlet portion on the first

conduit. The progression of the material along the first conduit and into the container is eased and/or assisted by the simultaneous substantial vacuum provided across the diameter of the container as provided by the second conduit and the vacuum generation means.

Preferably, the apparatus further comprises a second container which contains material which has preferably been pressurised and which is typically located upstream from the first container and which is further preferably located upstream from the intermediate or transfer pumping and/or vacuum generation means. Typically, the second container is connected to the first container such that material may be transferred therebetween. More preferably, the connection between the first and second containers passes through at least a portion of the intermediate or transfer pumping and/or vacuum generation means.

This allows a small amount (limited by the maximum volume of the intermediate or transfer pumping and/or vacuum generation means) of material to be sucked by the vacuum of the intermediate or transfer pumping and/or vacuum generation means from the second container and into an intermediate storage tank of the intermediate or transfer pumping and/or vacuum generation means. The pressurised contents of the second container typically assist in this regard by providing a positive pressure differential from the inside of the second container to the

outside. When the intermediate storage tank is full the intermediate or transfer pumping and/or vacuum generation means is then switched either manually or automatically to its pumping mode in order to pump the contents of the intermediate storage tank into the first container (which is assisted by the vacuum produced in the first container by the second conduit and vacuum generation means).

Typically, the first and/or second containers are large, silo-type containers which are typically cylindrical in shape. Preferably, the or each container is provided with a plurality of circumferentially arranged material chutes, preferably having a multi-sided (which in preferred embodiments is hexagonal) cross section, adapted to substantially prevent the material within the or each container from becoming compacted such that the material will no longer flow. Preferably, a separation device, which is preferably a cone having a multisided (which in preferred embodiments is hexagonal) cross section, is provided adjacent the chutes in order to substantially prevent large lumps of material from settling within the chutes. Alternatively, a standard conically shaped silo chute may be provided on the or each container.

An embodiment of the present invention will now be described with reference to the accompanying drawings, in which:-

Fig. 1 is a schematic diagram showing the flow of drill cuttings through apparatus in accordance with the present invention;
Fig. 2A is a schematic front view diagram of a tank used in the apparatus of Fig. 1;
Fig. 2B is a plan view of the top of the tank of Fig. 2A looking in the direction indicated by the reference lines B-B;
Fig. 2C is a partial cross-sectional side elevation of the tank of Fig. 2A;
Fig. 2D is a cross-sectional view of the valve arrangement on the bottom of the tank of Fig. 2A taken through the line C-C;
Fig. 2E is a partial cross-sectional view of the tank of Fig. 2C looking in the direction indicated by reference line D; and
Fig. 2F is a cross-sectional view of the tank of Fig. 2E taken through the line E-E showing the hexagonal chute and cone arrangement used in conjunction with a preferred embodiment of the apparatus.

Referring to Fig. 1, drill cutting material transportation apparatus 10 is provided. The apparatus 10 has a first vacuum/pump unit 12 connected to a holding tank 14 by a holding tank input pipe 16. The holding tank 14 is connected to a second vacuum/pump unit 18 by a holding tank output pipe 20. The second vacuum/pump unit 18 also connects to a transportation tank 22 via a transfer pipe 24. A vacuum pipe 26 connects to a third

vacuum/pump unit 28 and is in fluid communication with the inside of the transportation tank 22.

The vacuum/pump units 12, 18, 28 can be selectively switched between a vacuum mode which sucks material into an integrated transfer tank 30 and a pumping mode which blows material out of the integrated transfer tank 30 under pressure. The pressure differential required for both the vacuum and pumping modes is provided by an air compressor (not shown) attached to or integrated with the units 12, 18, 28. An example of a preferred unit 12, 18, 28 able to provide such pumping and vacuum capabilities is the SUPAVAC™ system distributed worldwide for the oil and gas industry by ITS Drilling Services Limited of Aberdeen, UK, but the skilled reader will realise that other conventional vacuum/pump units may also be suitable although such other conventional vacuum/pump units may not operate as quickly nor as efficiently.

The holding tank 14 and transportation tank 22 are large cylindrical tanks 14, 22 which are able to hold a relatively large volume of material. Typically, the holding tank 14 and transportation tank 22 are each able to hold around $15m^3$ to $20m^3$ of material, though it should be noted that smaller or larger tanks could be used without affecting the overall operation of the apparatus 10.

The holding tank 14 is provided with an external upright pipe 32 which extends from the bottom of the

tank 14 to the roof of the tank 14 at which point it terminates with an aperture 34, such that the interior of the external upright pipe 32 is in fluid communication with the interior of the holding tank 14. The bottom of the external upright pipe 32 is connected to the first vacuum unit 12 by the holding tank input pipe 16. Though the upright pipe 32 is provided externally in the apparatus 10 shown in the Figures, it should be appreciated that this upright pipe may alternatively be provided internally.

The bottom of the holding tank 14 may simply have a standard flat or conically shaped exit chute connected to outlet valves; however in the present and preferred embodiment (as best seen in Figs. 2C, 2E and 2F) a number of hexagonal chutes 36 are provided around the circumference of the tank 14 bottom in a honeycomb arrangement. A cone 40 having a hexagonal cross section is also provided in the centre of the circumferentially arranged hexagonal chutes 36, the purpose of which will be described subsequently. A suitable honeycomb shaped insert 36 is described in PCT Application No WO 00/55073, the contents of which are incorporated herein by reference.

The lowermost point of each chute 36 is provided with an outlet discharge valve 38 connected to discharge tubes 42 which converge onto the end of the holding tank output pipe 20.

A substantial number of components on the transportation tank 22 are substantially the same as the holding tank 14 and will therefore not be described further. In the following description, where this applies the same reference numeral has been used with an additional A being suffixed to the reference numeral.

Unlike the holding tank 14, the discharge tubes 42A of the transportation tank 22 are not connected to an output pipe in the arrangement shown in Fig. 1. In addition however, a further external upright pipe 44 is provided for the tank 22 opposite the external inlet upright pipe 32A. A vacuum pipe inlet aperture 46 is provided on the upper end of the additional external upright pipe 44, the purpose of which will be described subsequently. The additional external upright pipe 44 extends downwardly from the vacuum pipe inlet aperture 46 and connects to the vacuum pipe 26 which leads on to the third vacuum unit 28.

It should be noted that the length of the pipes 16, 20, 24, 26 in Fig. 1 are not to scale and have been altered for clarity. Indeed the transfer pipe 24 must be long enough to allow material to be transported from the vacuum unit 18 adjacent the holding tank 14 located on the rig (not shown) to the transportation tank located on the supply vessel (not shown) and this distance is likely to vary in length per application or project, typically from 10m to 200m in length.

In the following description the flow of drill cuttings throughout the apparatus 10 is illustrated by dark shaded arrows 48 on Fig. 1 and the negative suction (or vacuum) pressure differential created by the vacuum units 12, 18, 28 is illustrated by the unshaded arrows 50.

In operation, the vacuum mode of the first vacuum unit 12 is switched on. This creates a vacuum in the tank 30 which sucks drill cuttings 48 into the tank 30. It should be noted that the drill cuttings 48 are initially output from a primary drill cutting treatment equipment such as shale shaker/centrifuge etc. such as those typically used in drilling operations. The vacuum in the transfer tank 30 is sustained until the transfer tank 30 is filled with drill cuttings 48 which typically occurs when around 400 litres are contained within the tank 30. When full, the transfer tank 30 can no longer suck drill cuttings 48 and must now be emptied.

In order to empty the tank 30, the first vacuum unit 12 is switched to its pumping mode. In its pumping mode, compressed air is introduced into the tank 30 by the compressor (not shown). The increased pressure within the tank 30 expels the drill cuttings 48 within the tank 30 into the holding tank input pipe 16. The drill cuttings 48 are progressed up the upright pipe 32 due to pressure of compressed air in the tank 30 acting upon them until they reach the internal inlet aperture 34, at which point the

drill cuttings 48 enter the holding tank 14. Gravity causes the drill cuttings 48 to fall toward the bottom of the tank 14 and in so doing begins to fill the holding tank 14 from the bottom upwards.

Once the first vacuum unit 12 has expelled the contents of its tank 30 into the holding tank 14, it is then switched back to vacuum mode (either automatically or by a manual operator) in order to refill with drill cuttings 48 from the shale shaker/ centrifuge, etc. on the rig platform (not shown). Once filled with the next load of drill cuttings 48 the first vacuum unit 12 empties its contents into the tank 14 in a similar fashion as previously described. This cyclical filling and emptying of the tank 30 is repeated by the first vacuum unit 12 until the holding tank 14 is filled to a desired level determined by the user. The weight, and hence volume, of material within the holding tank 14 can be calculated by the user by subtracting the known empty weight of the holding tank 14 from the total weight of the holding tank 14 in operation whilst taking into account the effect of the specific gravity of the material (when calculating the volume).

It should be noted that the vacuum units 12, 18, 28 have very few moving parts e.g. impellers etc. since these could be easily clogged up by the highly viscous material passing through the units. Instead, the vacuum units 12, 18, 28 mainly comprise chambers and valves (not shown) which, in

conjunction with the compressed air supply can be manipulated to provide the necessary vacuum or pumping action as required.

Though a single holding tank 14 is shown in Fig. 1, in order to increase the capacity of the rig for retaining drill cuttings 48 before they must be offloaded, the rig may have a number of holding tanks 14. A typical number of holding tanks on the rig would be between 1 and 8 though more could be provided if the rig structure permits. When a number of holding tanks 14 are provided, the input pipe 16 is simply detached when the holding tank 14 to which it is connected is full, and is then reconnected to an empty holding tank 14.

When it is desired to transfer the contents of the holding tank 14 to, for example, a sea going supply vessel (not shown), one end of the holding tank output pipe 20 is connected to the discharge tubes 42 of the holding tank 14 to be emptied. The other end of the holding tank output pipe 20 is connected to the inlet of the second vacuum unit 18. The remaining space within the top of the holding tank 14 is then pressurised (while the discharge valves 38 are closed) either using an additional pressure source such as a pneumatic pump or the air compressor or using the first vacuum unit 12 in its pump mode. This pressurised zone results in the contents of the holding tank 14 being urged towards the bottom of the tank 14. The discharge valves 38 on the bottom of the holding tank 14 are then opened

and the tank 30 on the second vacuum unit 18 is then filled by creating a vacuum in the tank 30 in a similar way to that previously described for the first vacuum unit 30. The vacuum 50 created along the output pipe 20 by the second vacuum unit 18 (combined with the pressure exerted on the drill cuttings 48 within the holding tank 14 by the pressurised zone) draws the drill cuttings 48 from the holding tank 14. When the tank 30 on the second vacuum unit 18 is filled with drill cuttings 48, the vacuum unit is switched off in preparation for pumping the drill cuttings 48 into the transportation tank 22 located on, for example, the supply vessel. A number of these transportation tanks 22 may be provided on the supply vessel e.g. from 1 to 20 tanks in order to maximise the drill cutting transport capacity of the supply vessel.

When the unit 18 is switched to pumping mode it begins to pump the drill cuttings 48 along the transfer pipe 24 by introducing compressed air into the tank 30. While the drill cuttings 48 are being pumped along the transfer pipe 24, the third vacuum unit 28 simultaneously operates in its vacuum mode in order to create a vacuum along the vacuum pipe 26. The vacuum present in the vacuum pipe 26 is communicated to the inside of the transportation tank 22 due to the open end of the vacuum pipe 26 provided by the vacuum pipe inlet aperture 46. The effect of the pumping action provided by the second vacuum unit 18 combined with the vacuum created in the transportation tank 22 provides a large pressure

differential across the drill cuttings 48 travelling along the length of the transfer pipe 24. The magnitude of this pressure differential is substantially greater than that obtainable by only performing one of the pumping or sucking operations and is ideally suited to ensuring that the viscous material e.g. drill cuttings (which have a tendency to stick together and block pipes components) continue to flow through the apparatus 10. This is even true over the relatively long distance required to transfer the drill cuttings 48 (through the transfer pipe 24) from the rig platform to the supply vessel.

When the drill cuttings 48 reach the internal inlet aperture 34A they escape into the transportation tank 22 and fall under the action of gravity toward the bottom of the tank 22. It should be noted that the pressure differential across the transportation tank inlet aperture 34A and the vacuum pipe inlet aperture 46 is not great enough to suck the drill cuttings across the gap between these apertures. In this regard, when the drill cuttings 48 within the transportation tank 22 reach a certain level the transfer operation should be switched to another transportation tank (not shown) since if the transportation tank 22 is over filled, drill cuttings 48 would be more likely to enter the vacuum pipe 26, which is undesirable. When each transportation tank 22 on the vessel has been filled to the desired level, the transportation tank input

pipe 24 is disconnected and the vessel may proceed to the onshore based processing/disposal facility.

The cone 40, 40A in the holding tank 14 and transportation tank 22 respectively serve to divide the drill cuttings 48 falling from the inlets 34, 34A between the chutes 36, 36A. The relatively small cross section of the plurality of chutes 36, 36A (when compared to the situation if only a single chute were located on the bottom of the tanks 14, 22) provide a number of smaller individual areas upon which the material above can press upon which makes hard packing of the drill cuttings located at the bottom of the tanks 14, 22 less likely.

When the transportation tanks 22 are to be emptied the remaining space within the top of the transportation tank 22 can be pressurised (while the discharge valves 38A are closed) either using an additional pressure source such as a pneumatic pump (not shown) or using the third vacuum unit 28 in the pump mode (and/or if it is available, the second unit 18, as will be described subsequently). This pressurised zone results in the contents of the transportation tank 22 being urged towards the bottom of the tank 22 in a similar fashion to that previously described for the holding tank 14. The discharge valves 38A on the bottom of the transportation tank 22 are then opened and the contents either removed simply due to the pressurisation in the transportation tank 22 or by attaching it to a further vacuum unit (not shown).

Modifications and improvements may be made to the embodiments hereinbefore described without departing from the scope of the invention.

For instance, although the embodiment of the apparatus 10 described above is used to transfer drill cuttings, the apparatus 10 may be used to transfer any material which will flow through a pipe, and is particularly useful for transporting materials which would otherwise tend to become stuck in pipes.

The vacuum units 12, 18 may be substituted with any vacuum unit, particularly those capable of both acting as a vacuum and as a pump without becoming clogged with the material passing though it. The vacuum unit 28 may be substituted by a unit capable of creating a powerful enough vacuum.

Furthermore, the second vacuum/pumping unit 18 could instead be situated on the supply vessel rather than on the drilling rig; in this case, the transfer pipe would be regarded as pipe 20 (suitably lengthened) and the pipe 24 would be suitably shortened.

CLAIMS:-

1. A method of transferring material from a first location to a second location comprising the steps of:-

providing a container containing fluid;

transferring material from a first location outside of the container to a second location inside the container; and

at least partially evacuating fluid from within the container in order to facilitate progression of the material into the container.

2. A method according to claim 1, wherein the transfer of material from the first location to the second location and evacuating the fluid from the container are performed substantially simultaneously.

3. A method according to either of claims 1 or 2, wherein the method further comprises the step of transferring the material along a first conduit under application of pressure upstream of the material, in order to progress the material from a first location outside of the container to a second location inside the container.

4. A method according to claim 3, wherein the method further comprises the step of at least partially evacuating air from the container along a second conduit in order to substantially create a vacuum within the container.

5. A method according to any preceding claim, wherein the fluid is at least partially evacuated from the container whilst substantially avoiding removal of the material from the container.

6. A method according to any preceding claim, wherein the method further comprises the step of providing a second container upstream of the first container.

7. A method according to claim 6, wherein the second upstream container provides a temporary storage facility for material to be transported.

8. A method according to either of claims 6 or 7, wherein the method further comprises the step of providing a first pumping means for pumping material into the second container under pressure such that the material is deposited in the second container prior to being transferred to the first container.

9. A method according to claim 8, wherein pressure is applied to the second container and the material therein when the second container contains a desired level of material.

10. A method according to claim 9, wherein the second container is then emptied by evacuating at least a portion of the material within the second container, along a discharge conduit.

11. A method according to claim 10, wherein the action of evacuating at least a portion of the material along the discharge conduit is assisted by the pressure applied to the second container.

12. A method according to either of claims 10 or 11, wherein discharge conduit is in fluid communication with the first conduit via an intermediate vacuum generation means in order to allow the material from the second container to be conveyed to the first container.

13. A method according to any preceding claim, wherein the first container is located on a transportation means and the second container is located proximal to the first pumping means and also is located proximal to a supply of the material in the form of a primary drill cuttings source on a drilling rig.

14. A method according to any preceding claim, wherein the intermediate transfer vacuum generation means is located proximal to and downstream of the second container.

15. A method according to any preceding claim, wherein a transfer conduit connects the intermediate vacuum generation means to the first container.

16. A method according to any preceding claim, wherein the material comprises drill cuttings.

17. Material transfer apparatus comprising:-

a container containing fluid;

material transfer means adapted to transfer material from a first location outside the container to a second location inside the container; and

material urging means adapted to facilitate transfer of the material from the first location to the second location by at least partially evacuating fluid from within the container.

18. Material transfer apparatus according to claim 17, further comprising a first tubular conduit which passes through an inlet portion of the container and an intermediate vacuum generation means connected thereto.

19. Material transfer apparatus according to claim 18, wherein the intermediate vacuum generation means comprises a pump and a vacuum device and is adapted to be selectively switched between the pumping and vacuum producing modes as desired.

20. Material transfer apparatus according to claim 19, wherein the intermediate vacuum generation means also comprises an intermediate storage tank and is located upstream of the container.

21. Material transfer apparatus according to claim 20, the material urging means comprises a second tubular conduit which passes through an outlet portion of the container.

22. Material transfer apparatus according to claim 21, wherein the material urging means further comprises vacuum generation means connected thereto.

23. Material transfer apparatus according to either of claims 20 or 21, wherein the inlet and outlet portions are spaced apart across a diameter of the first container in order to prevent material exiting the inlet portion from entering the outlet portion.

24. Material transfer apparatus according to claim 23, wherein a filter is provided on the outlet portion to further prevent the material from entering the outlet portion and hence the vacuum generation means.

25. Material transfer apparatus according to either of claims 23 or 24, wherein the inlet and outlet portions are located toward the upper end of the first container.

26. Material transfer apparatus according to any of claims 17 to 25, wherein the fluid is air.

27. Material transfer apparatus according to any of claims 17 to 26, wherein the material is hydrocarbon exploration and production industry by-products in the form of drill cuttings.

28. Material transfer apparatus according to any of claims 17 to 27, wherein the apparatus further comprises a second container which contains

pressurised material and is located upstream from the first container and is further located upstream from the intermediate vacuum generation means.

29. Material transfer apparatus according to claim 28, wherein the second container is connected to the first container such that material may be transferred therebetween.

30. Material transfer apparatus according to claim 29, wherein the connection between the first and second containers passes through at least a portion of the intermediate vacuum generation means.

31. Material transfer apparatus according to any of claims 28 to 30, wherein the first and second containers are substantially cylindrical silo containers.

32. Material transfer apparatus according to any of claims 28 to 31, wherein the or each container is provided with a plurality of circumferentially arranged material chutes, having a multi-sided cross section, adapted to substantially prevent the material within the or each container from becoming compacted such that the material will no longer flow.

33. Material transfer apparatus according to claim 31, wherein a separation device is provided adjacent the chutes in order to substantially prevent large lumps of material from settling within the chutes.

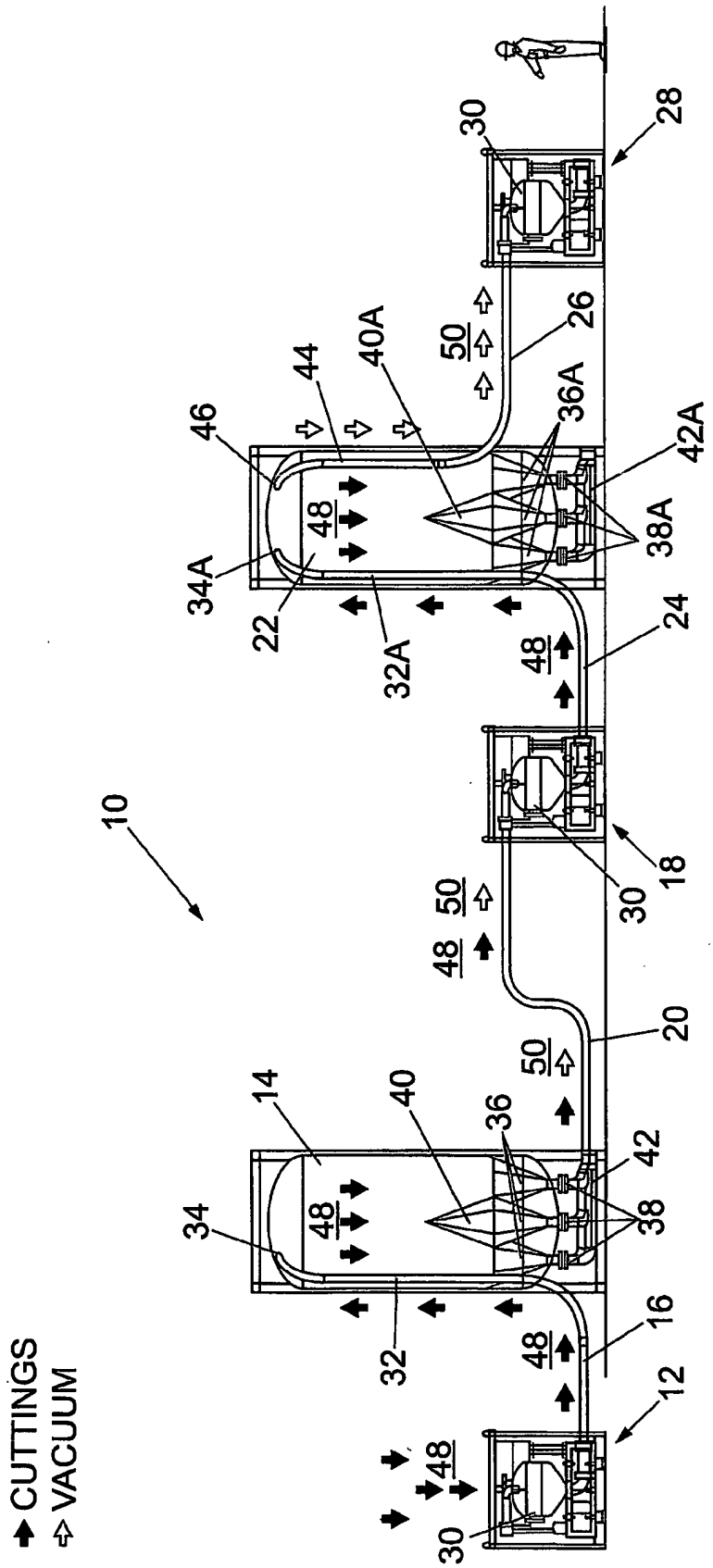


Fig. 1

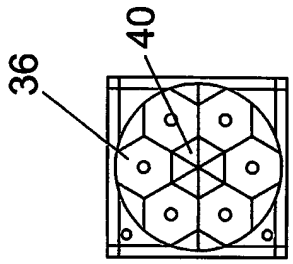


Fig. 2F

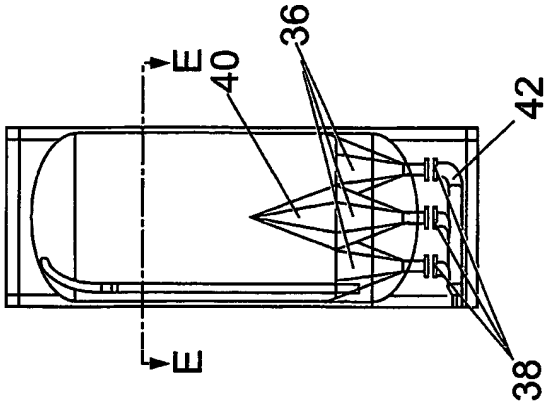


Fig. 2E

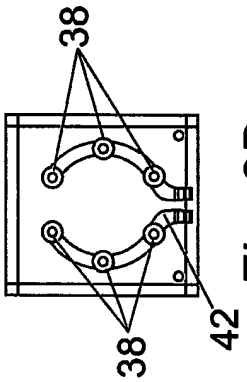


Fig. 2D

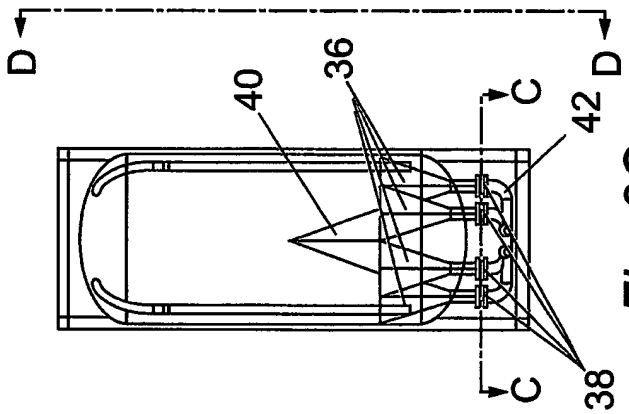


Fig. 2C

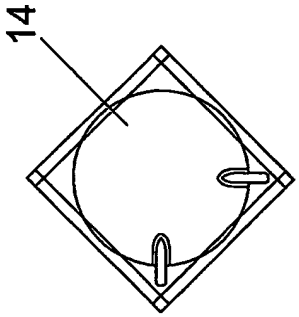


Fig. 2B

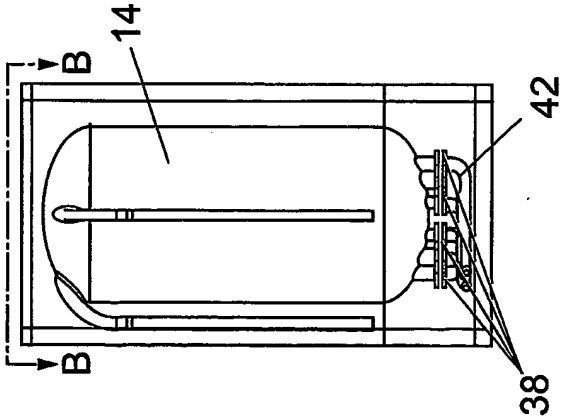


Fig. 2A

INTERNATIONAL SEARCH REPORT

Inter ll Application No
PCT/GB2005/001606

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 096 965 A (ACOUSTI THERM CEILINGS & LININGS LTD) 27 October 1982 (1982-10-27)	1,2,5, 14-18, 26,27
A	page 2, line 55 - page 3, line 1; abstract; figure 1	3,4, 6-13, 19-25, 28-33
X	GB 2 087 335 A (DUNDEE CEMENT CO; CYCLONAIRE CORP) 26 May 1982 (1982-05-26)	1,2,5, 14-18, 26,27
A	page 1, lines 5-14; page 2, line 87 - page 3, line 29; page 3, line 94 - page 4, line 17; page 4, lines 58-66; abstract; figure 2	3,4, 6-13, 19-25, 28-33
Y	WO 00/55073 A (CURLE, WILLIAM) 21 September 2000 (2000-09-21)	32,33
A	page 28, line 7 - page 29, line 7; figures 7-14	1-31
A	US 2002/187012 A1 (GRASSHOFF HERBERT) 12 December 2002 (2002-12-12) abstract; figures	1-33

INTERNATIONAL SEARCH REPORT

Inter ial Application No
PCT/GB2005/001606

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 4695205	A	22-09-1987	NONE		
DE 2437799	A1	19-02-1976	NONE		
GB 2096965	A	27-10-1982	NONE		
GB 2087335	A	26-05-1982	AU	7548881 A	27-05-1982
			DE	3141065 A1	24-06-1982
			IT	1144780 B	29-10-1986
			JP	57093829 A	11-06-1982
WO 0055073	A	21-09-2000	AU	3439800 A	04-10-2000
			EP	1163171 A1	19-12-2001
			WO	0055073 A1	21-09-2000
			GB	2356627 A ,B	30-05-2001
US 2002187012	A1	12-12-2002	DE	10127427 A1	12-12-2002
			CA	2449344 A1	12-12-2002
			CN	1514796 A	21-07-2004
			WO	02098772 A1	12-12-2002
			EP	1399376 A1	24-03-2004
			JP	2004527430 T	09-09-2004

INTERNATIONAL SEARCH REPORT

Intern al Application No
PCT/GB2005/001606

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B65G53/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B65G E21F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	US 4 695 205 A (LEVINE ET AL) 22 September 1987 (1987-09-22) column 2, line 55 - column 3, line 65; column 4, line 10 - column 5, line 45; claims; figure	1-7, 14-18, 26-31 32,33 8-13, 19-25
X A	DE 24 37 799 A1 (SPITZER SILOFAHRZEUGE KG, 6950 MOSBACH; SPITZER SILO- FAHRZEUGWERK KG,) 19 February 1976 (1976-02-19) page 7, line 19 - page 9, line 16; page 10, line 6 - page 11, line 7; page 12, lines 13-23; figure 1	1,2,5, 15-19, 26,27 3,4, 6-14, 20-25, 28-33

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 July 2005	03/08/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Clivio, E

Form PCT/ISA/210 (second sheet) (January 2004)

This Page is Inserted by IFW Indexing and Scanning Operations and is not part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☑ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.
As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.